YOR920010319US1

## REMARKS

Claims 1-36 are all the claims pending in the application. Claims 1-29 stand rejected on prior art grounds. Claims 30-36 are added herein. No new matter is being added. Applicants respectfully traverse these objections/rejections based on the following discussion.

### I. The Prior Art Rejections

Claims 1-9 stand rejected under 35 U.S.C. §102(e) as being anticipated by Colbert et al. (U.S. Patent Publication No. 2002/0084410) hereinafter "Colbert". Claims 1-29 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Colbert, as applied to Claims 1-9. Applicants respectfully traverse these rejections based on the following discussion.

Colbert teaches macroscopically manipulable nanoscale devices made from nanotube assemblies. The article of manufacture comprises a macroscopic mounting element capable of being manipulated or observed in a macroscale environment, and a nanoscale nanotube assembly attached to the mounting element. The article permits macroscale information to be provided to or obtained from a nanoscale environment. A method for making a macroscopically manipulable nanoscale devices comprises the steps of (1) providing a nanotube-containing material; (2) preparing a nanotube assembly device having at least one carbon nanotube for attachment; and (3) attaching said nanotube assembly to a surface of a mounting element.

Applicants submit that Colbert does not anticipate claims 1-9, and that therefore the claimed invention is patentably distinct over Colbert. Moreover, Applicants submit that claims 1-29 are not obvious extensions of Colbert, and that these claims are also patentably distinguishable over the prior art of record.

While the application of Colbert and the claimed invention both relate to improved probes for scanning probe microscopy (SPM), formed by attaching nanoscale elements to the tip of a conventional SPM probe, the inventions are significantly and patentably different in the respective intended application, geometry, materials used, and fabrication methods employed.

Intended Application

The invention in Colbert is geometrical. That is, nanotube tips are sharper and can access the bottoms of high aspect-ratio structures. One of the advantages of the claimed invention is functional. That is, nanoparticles can be synthesized with a wide range of desirable material properties that allow imaging with novel modalities.

Geometry

The differing aims of the two inventions (Colbert and the claimed invention) are reflected in their different respective geometries. Colbert uses nanotubes; i.e., quasi 1-dimensional objects, whereas the claimed invention uses nanoparticles; i.e., quasi 0-dimensional objects. Nanotubes are particularly suited for interacting with objects with high aspect-ratio. However, due to their extended geometry, the tips are susceptible to thermal fluctuations and breakage. Furthermore, it is difficult to align nanotubes so that they protrude from the tip in the desired direction. An additional drawback of nanotube tips is that it is difficult to prevent multiple tips from forming on the same probe.

In contrast, nanoparticle tips as provided by the claimed invention, do not suffer from the thermal fluctuations, fragility, alignment problems, and difficulties with multiple tips associated with nanotube tips. A coating of nanoparticles conforms to the shape of the underlying substrate, and thus does not substantially change the geometry.

Moreover, nanoparticles may be synthesized with a high degree of geometrical control. With current technology, there is little geometrical control in the synthesis of nanotubes. Thus, nanoparticle tips show less variability than nanotube tips.

Materials

The invention of Colbert does not substantially address the material properties of the tip: in the preferred embodiment the tips are composed of carbon nanotubes. It is currently impractical to select a carbon nanotube with predetermined electronic properties. The functionalization procedures described by Colbert (chemical modifications to the apex, endohedral filling) are currently very complex procedures with low rates of success.

In contrast Colbert, the nanoparticles of the claimed invention have been synthesized from a wide range of materials with useful magnetic, electronic, optical, chemical, and mechanical properties. Furthermore, in an embodiment of the claimed invention, the inventors take advantage of this material control by imparting magnetic sensitivity to an SPM tip. Furthermore, the surfaces of nanoparticles are more chemically reactive than are the surfaces of carbon nanotubes. Nanoparticles are easily functionalized with a wide range of organic chemicals; nanotubes are not, which is yet another distinction between Colbert and the claimed invention.

Again, the emphasis of the claimed invention is to impart novel functional properties to the tip, while the emphasis of the invention of Colbert is to impart novel geometry to the tip. Thus, claims 1-9 are neither taught nor suggested by Colbert.

Fabrication

The claimed invention also differs from Colbert in that in the claimed invention the nanoparticles are deposited from a fluid state. Colbert makes a solution of nanotubes as an

intermediate step in their process, but then they deposit the tubes onto the tip from a dry state. Deposition directly from a fluid state has several advantages: 1) The nanoparticles may equilibrate to form a highly ordered array on the tip; 2) The process does not involve solid-solid contact, so there is a smaller chance of damaging the tip; 3) Deposition from a fluid can be performed in a parallel manner on an entire wafer of tips. In contrast, dry deposition of nanotube tips must be done one-by one; 4) Chemical modifications may be performed in situ to attach the nanoparticles to the tip.

Additionally, due to the low solubility of nanotubes, it would not be practical to deposit them directly from a solution. Thus, deposition from a solution is not an obvious extension of Colbert because it only works with nanoparticles, and not with nanotubes. Furthermore, the annealing process of the claimed invention differs from that of Colbert in that thermal treatment may induce chemical changes in the nanoparticles. For instance, annealing may substantially change the magnetic properties of nanoparticles (see Sun SH, Murray CB, Weller D, et al., "Monodisperse FePt nanoparticles and ferromagnetic FePt nanocrystal superlattices," Science 287 (5460): p. 1989 (2000)). In contrast, the annealing step disclosed by Colbert is primarily to eliminate defects in the nanotubes.

Claims 30-36 are added herein, and state that the "nanoparticles are spherical." This is shown most clearly in Figures 1A-1C, and 2B-2G as originally filed along with descriptions of diameter ranges of the nanoparticles, which is similarly described in paragraphs 0026 and 0029 of the specification as originally filed.

Therefore, Applicants respectfully submit that the cited prior art of record do not teach or suggest the features defined by independent claims 1, 10, and 24-28 and as such, claims 1, 10, and 24-28 are patentable over Colbert. Further, dependent claims 2-9, 11-23, and 29, are

similarly patentable over Colbert, not only by virtue of their dependency from patentable independent claims, respectively, but also by virtue of the additional features of the invention they define. In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the rejections.

## II. Formal Matters and Conclusion

In view of the foregoing, Applicants submit that claims 1-36, all the claims presently pending in the application, are patentably distinct from the prior art of record and are in condition for allowance. Furthermore, no new matter is being added. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary. Please charge any deficiencies and credit any overpayments to Attorney's Deposit Account Number 50-0510.

Respectfully submitted,



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Mohammad S. Rahman
Reg. No. 43,029
McGinn & Gibb, PLLC
2568-A Riva Road, Suite 304
Annapolis, MD 21401
(301) 261-8071 - voice
(301) 261-8825 - fax
Customer No. 28211